

1 Title: REINFORCED PAPER PRODUCT AND METHOD FOR MAKING SAME

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4 This utility application claims priority to U.S. Provisional Application Serial
5 No. 60/421,497, filed October 28, 2002, which is incorporated herein by reference
6 for all purposes.

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8 BACKGROUND OF THE INVENTION

9 Over past centuries paper products have been utilized in various packaging,
10 binding, shipping, storage and building applications in modern life. Currently, most
11 applications incorporate certain common features, namely, single or multi-layered
12 paper sheets are cut, pasted, glued or molded into a desired shape or configuration
13 with various specified dimensions. The tensile strength and abrasive resistance of
14 current paper products is severely limited by the strength of the underlying paper
15 composition. Often the paper strength is inadequate for commercial needs such as
16 shipping, storage, and inter-modal transshipments. Thus, the materials contained or
17 packaged by current paper products will frequently spill out as the result of paper
18 failure, or unexpected breakage or rupture. Such failure causes significant loss of
19 materials and time, workplace contamination and even environmental damage.

20 The present inventive product and method yields an increased tensile strength
21 and abrasive resistance to the composite product. Depending upon the composition
22 of the reinforcing fiber selected for inclusion in the composite product, the strength

1 and abrasive resistance may be increased hundreds of fold. Further, the composite
2 product may be reused significantly reducing overall paper consumption. With
3 appropriate selection of natural or synthetic fibers, the composite product may be
4 totally recyclable.

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6 **BRIEF DESCRIPTION OF THE DRAWINGS**

7 Fig. 1 is a perspective view of a first embodiment of the composite paper
8 product of the present invention.

9 Fig. 1A is a detailed view of the fiber strands overlapping.

10 Fig. 2 is a perspective view of a second embodiment of the composite paper
11 product of the present invention.

12 Fig. 3 is a perspective view of a third embodiment of the present invention.

13 Fig. 4A is a top plan view of a first fiber strand arrangement of the present
14 invention.

15 Fig. 4B is a top plan view of a second fiber strand arrangement of the present
16 invention.

17 Fig. 5 is a top plan view of an overlapping of first and second fiber strand
18 layers of the present invention.

19 Fig. 6 is a perspective view of an embodiment of the present invention
20 illustrating an insulation composition covering a layer of paper of the present
21 invention.

1 Fig. 7 illustrates an abrasive resistant covering of the present invention with a
2 gypsum layer sandwiched therebetween.

3 Fig. 8 is a flow diagram of the process of the present invention.
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5 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

6 The reinforced composite paper product of the present invention presents a
7 unique reinforcement of woven natural and synthetic fiber nets glued or bonded
8 between two or more layers of natural, standard paper sheets. Fig. 1 illustrates the
9 simplest configuration of the present inventive composite product 10.

10 A first paper layer 12 and a second paper layer 14 have a bonded fiber strand
11 network 16 therebetween. Fig. 1A illustrates a detailed view of a pattern of the fiber
12 strand network 16. The fiber network 16 is made up of at least two sets of
13 overlapping fiber strands (each strand is comprised of a multiplicity of individual
14 fiber filaments) which are woven and folded between the paper layers 12 and 14 as
15 described below. The fiber strand network 16 may be made of the following man-
16 made or natural fibers including but not limited to: polyester staple, polyester
17 conjugate, acrylic, viscose staple, glass, nylon, polypropylene, acetate, aramid,
18 asbestos, charvet, elastomerr, glass fibers, latex, manufactured fiber, metallic fibers,
19 modacrylic nylon, olefin fiber, PBI, polyester, protein base fibers, rayon, Spandex®
20 Sulfar®, Vivyon®, polyamide fibers, vinyl, wool and related mammalian fibers, silk,
21 jute and kenaf, other long vegetable fibers, abaca, banana, sisal, henequen, flax,
22 ramie, hemp, sunn, and coir, cotton, cellulose acetate and triacetate fibers.

1 As would be understood by one of ordinary skill in the art, the reinforced
2 composite product 10 may be used for boxes, bags, molded containers, thermal
3 insulation, waterproofing, corrosion resistant fire retardant building or packaging
4 materials, etc. Application of the present inventive fiber reinforced paper product
5 may result in the following features: waterproofing, tensile strength reinforcement,
6 thermostability, aging retardation, high anti-abrasion capability, and minimize
7 breakage or ruptured rate. With selection of an appropriate fiber-net material and a
8 gluing compound such as the Vinylon® soluble yarn without condensating
9 aldehydes-treatment, and a PVA based glue, the composite paper product may be
10 easily dissolved in warm water and become totally recyclable without pollution to
11 the environment. The paper composite product of the present invention may be
12 applied to packaging or bagging of all kinds, powdered and particulate materials for
13 agriculture grains, animal feed, cheese, starch and the floury food products, cement,
14 fertilizers, pesticides, herbicides, talcum powder, titanium white, carbon black,
15 calcium carbide, asphalt, and all kinds of chemical and mineral products.

16 Fig. 2 illustrates an exploded perspective view of an embodiment of the
17 present invention 10a wherein multiple layers of paper 12a, 13a, 13b, and 14a are
18 separated by multiple layers of fiber strand sets 16a, 16b, 16c, and 16d. Fig. 2
19 illustrates the strand sets 16a, 16b, 16c, and 16d as if they are woven sheets for
20 simplicity purposes. However as will be understood below that the warp and woof
21 (or weft) of the strands are laid down in a weaving process. It is believed that fiber

1 strand network 16 may be woven as separate sheets or nets and placed and glued or
2 bonded between the paper layers and the layers.

3 It should be noted in Fig. 2 that a plurality of first fiber strands 16a and 16c
4 extend in a first linear direction and each separate first fiber strand (made up of
5 multifiber filaments) is generally parallel to the next separate strand. This is a first
6 direction or orientation for the first fiber strands 16a. A second plurality of fiber
7 strands 16b and 16d extend in a second diagonal direction and each second fiber
8 strand is generally parallel to the next strand. As shall be noted below, a third
9 diagonal direction may be used on a portion of the second strands 16a and 16d which
10 is opposite the second diagonal direction.

11 In the embodiment of Fig. 2, it will be seen that two paper sheets or layers
12 13a and 13b may be glued adjacent one another without detracting from the
13 advantages of the present invention. Either or both of the outermost sheets of paper
14 12a and 14a may be coated, covered, or treated with a variety of compositions to
15 integrate special characteristics to the composite product. These compositions may
16 include a water proofing treatment composition, a corrosion proofing or resistance
17 treatment composition, a thermal insulation composition, a fire retardation
18 composition, and an abrasion resistance composition.

19 A binding composition or glue 15 is disposed or deposited between the paper
20 layers and retains the first fiber strands 16a and 16b and the second fiber strands 16c
21 and 16d in the directions noted above. The glue 15 also binds or adheres the paper

1 layers together to create a unitary, composite, reinforced fiber paper product or sheet.
2 As noted below, the glue may be applied first to the warp yarn.

3 Fig. 3 illustrates another embodiment of the present invention wherein a
4 plurality of paper sheets 12a, 13a, 13b, 13c, and 14a are separated by a plurality of
5 first fiber strand sets 16a extending in a first direction and a plurality of second fiber
6 strand sets 16b extending in a second diagonal direction between two adjacent layers
7 of paper. As noted above, a binding composition such as polyvinyl alcohol (PVA) or
8 other biodegradable glue 15 is used to hold the layers of paper and fiber together in a
9 unitary sheet. The fibers themselves may be made of PVA.

10 In Figs. 4A, 4B, and 5, the fiber strand network 16 is shown in greater detail.
11 Fig. 4A illustrates the first fiber strand pattern 16a which is made up of generally
12 transverse, parallel rows of fiber filament bundles. Fig. 4B shows a second fiber
13 strand pattern 16c with a first portion of the strands 20 extending diagonally in a
14 generally parallel configuration in one direction and a second portion of fiber strands
15 22 extending diagonally in a generally parallel configuration in an opposite direction.
16 Fig. 5 illustrates how the two patterns 16a and 16c have been overlain to form the
17 network 16.

18 Figs. 6 and 7 are illustrative of how the composite product of the present
19 invention may be combined with insulation material 40 (Fig. 6) or even composite
20 gypsum board 50 (Fig. 7) to form very functional building materials. In Fig. 6, an
21 exterior paper layer 30 has been bonded to a fiber strand network 16 and an interior

1 paper layer 32. This forms a very strong construction paper product to which an
2 insulation material 36 has been bonded.

3 Fig. 7 illustrates a different building product 50 which incorporates two
4 sheets of the composite reinforced paper product 31 and 33 with a section of gypsum
5 material sandwiched therebetween. This product 50 has a very high abrasion
6 resistance and may be used in numerous building applications.

7 As should be understood, the composite paper product of the present
8 invention may be used to make bags, boxes, containers, tarps, cups and many other
9 paper products which may be enhanced by its reinforced strength and recyclable
10 attributes.

11 A preferred process for constructing or manufacturing the present inventive
12 paper product is illustrated in Fig. 8 and is described as follows:

- 13 1. The multiple lines of warp yarn 100 are rolled off the spindles 101.
- 14 2. All lines of the warp yarn are dipped through the glue bath 102.
- 15 3. At the same time when the warp yarn 100 begins its movements, pre-
16 sized interior layer of paper 104 is rolled off the paper spool 105 and is pulled under
17 the warp yarn 100. A portion of the glue is disposed on the paper layer 104.
- 18 4. Preset lines of weft (or woof) yarn 110 are pulled to form a transverse
19 net and passed above the warp yarn and the interior paper.
- 20 5. The net 16 formed by the yarn and the interior paper are moved by
21 rollers and warped into a paper tube 112.

1 6. The printed exterior paper 114 is pulled to wrap around the tube and
2 moved through the calendar 116 to press into a tube made of composite paper 118
3 with the fiber net reinforcement.

4 7. The tube is rolled through a pinhole-punching machine 120.

5 8. The punched paper tube 122 is then rolled through the margin-folding
6 machine 124.

7 9. The folded paper tube 126 is then moved through the bag-cutting
8 machine 128 based on preset length.

9 10. The bag 130 is then dropped into a bag bin 132 for further processing.

10 In case a flat composite paper sheet is the final product, the paper tube made
11 through step number 6 will be diverted to a horizontal cutting machine which can cut
12 the tube into flat sheet.

13 It should be understood in the current process of Fig. 8 that with the selection
14 of the yarns made of polyvinyl alcohol (PVA), the composite paper products are
15 totally recyclable. Normally, PVA is frequently applied in paper making and can be
16 dissolved easily and the temperature above 200° F. Multiple layers of paper with
17 the fiber net glued between the paper can easily be produced with the sequential
18 application of the present inventive production process.

19 Generally, the invented composite paper with the fiber net and the PVA glue
20 is water resistant in normal conditions. In view of the strength requirements and
21 preferences of fiber nets made of natural or synthetic material, different fiber nets
22 can be applied.

1 Although the invention has been described with reference to a specific
2 embodiment, this description is not meant to be construed in a limiting sense. On the
3 contrary, various modifications of the disclosed embodiments will become apparent
4 to those skilled in the art upon reference to the description of the invention. It is
5 therefore contemplated that the appended claims will cover such modifications,
6 alternatives, and equivalents that fall within the true spirit and scope of the invention.

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